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AWJ PRODUCTION TECHNOLOGY SYSTEM TECHNOLOGY HEAD VIBRATIONS FORMATION DUE TO WATER PRESS CHANGES

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ABSTRACT: The topic of presented paper is studying the impact of high-pressure pump on the vibration of technological head of manufacturing system with AWJ technology in the production process. The article aims to point out one of the sources of unwanted vibrations, which can subsequently be reflected in the quality of cut surface.
KEYWORDS: water jet, vibrations, amplitude of vibration acceleration

❖ INTRODUCTION

A water jet technology is a complicated system that uses high pressured hydrodynamic process which can be described within the terms of jet technology. The process itself requires as effective and economical use of the water jet energy as possible. This presumption is directly related to optimal determination of water jet production and technology parameters considering basic physical properties of liquid as a cutting medium and hydrodynamic laws.

The factors influencing the machined surface can be expressed and consecutively identified in categories as factors of liquid basic physical properties and their hydrodynamic regularities, technical factors influencing hydro-erosive production process and technological factors influencing hydro-erosive surface of the cutting.

Motivation of presented work is to identify sources of vibration in the process of AWJ-cutting as it is believed to be one of the most important factors deteriorating quality of the result. Therefore, the presence and the magnitude of the vibrations of the cutting head and its relations with high-pressure pumping system in the AWJ-cutting process have been studied using experimental monitoring system.

❖ EXPERIMENTAL MEASUREMENT

A miniature piezoelectric accelerometer Brüel & Kjær (type: 4507-B-004 parameters: IEPE, TEDS, 1-axis, 100mV/g) was used for vibration measurements, which was fixed onto the water jet technological head using bee wax. Signals processing and evaluation was carried out with modular system, which is based on National Instruments CompactDAQ platform with specialized function module NI - 9233 for vibrations measuring. Signal processing was performed using graphic programming software LabVIEW Signal Express extended with Sound and Vibration Toolkit module which contains a set of tools for vibrations and sounds evaluation.

The experiments were carried out in the firm Watting Prešov Ltd. where during technical GRES ceramics cutting the pressure values of the pump were varied: 200 MPa, 250 MPa and 350 MPa. The technological head speed was 600 mm.min^{-1}. The table 1 summarizes the conditions under which the experiments were performed and for which evaluated graphic dependencies are valid.

Table 1. Conditions of performed experiments

Cut material	GRES ceramics
Distance of the technological head from the material.	2-3 mm
Water nozzle diameter	0,25 mm
Focusing tube diameter	1,02 mm
Cut material thickness	10 mm
Abrasive type and abrasive mesh	Indian garnet mesh 80
Abrasive mass flow	200 g/min
Pump pressure	250 MPa
	300 MPa
	350 MPa

❖ RESULTS AND DISCUSSION

Figures 1, 2 and 3 represent graphic dependencies of average value of amplitude of vibration acceleration on a given frequency at a given pump pressure value.

Figure 4 presents a graphical comparison of the three dependencies of maximal values of vibration acceleration amplitude on given frequency.

Maximal value of vibration acceleration amplitude for analysed pump pressure value was protracted for each interval within 200 Hz frequency interval. The amplitudes of vibration acceleration less than 25.10^{-6} g were neglected. This limit value was stated from background vibrations measured in standby mode (a mode when the device is on and waits for programme activating) are not considered to be generated due to technological processes of interest.

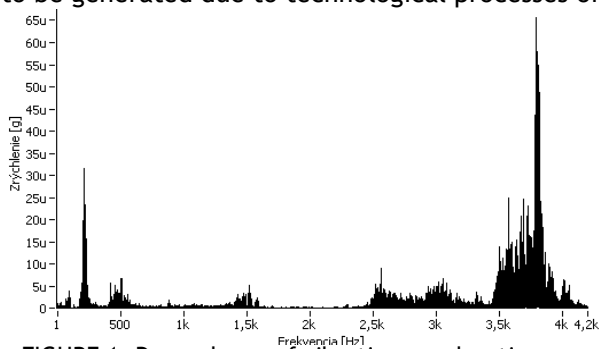

FIGURE 1. Dependence of vibration acceleration on given frequency (pressure 250 MPa). Legend: zrýchlenie = acceleration, frekvencia = frequency

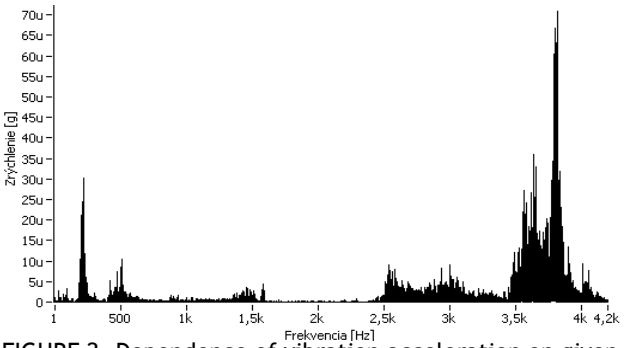

FIGURE 2. Dependence of vibration acceleration on given frequency (pressure 300 MPa). Legend: zrýchlenie = acceleration, frekvencia = frequency.

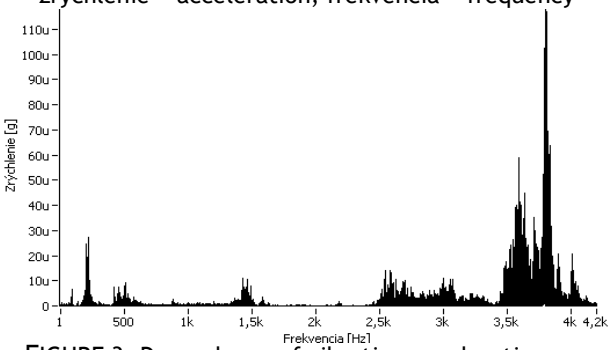

FIGURE 3. Dependence of vibration acceleration on given frequency (pressure 350 MPa). Legend: zrýchlenie = acceleration, frekvencia = frequency.

Low values of vibration were measured at pump pressure of 250 MPa where the value of vibration acceleration amplitude within frequency interval from 3,4 kHz to 4,2 kHz is almost half of the previous analysed pressure values and within frequency interval from 200 Hz to 400 Hz no significant values of vibration acceleration amplitudes were identified.

On the base of the presented graphic dependencies can be determined that the highest vibration values were measured at the pressure values of 300 MPa and 350 MPa within frequency interval from 200 Hz to 400 Hz where the value of vibration acceleration does not exceed 4.10^{-5} g and within frequency interval from 3 400 Hz to 4 200 Hz where maximal value of vibration acceleration amplitude oscillates around the value of $1,6.10^{-4}$ g.

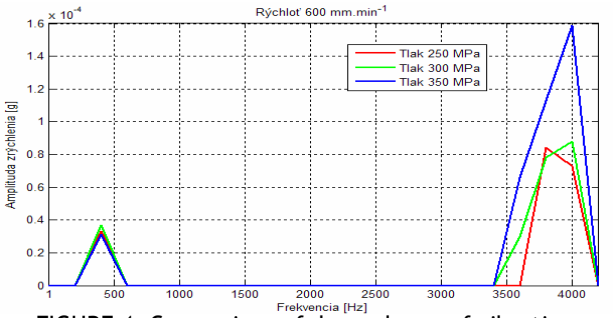

FIGURE 4. Comparison of dependence of vibration acceleration on given frequency at three analysed pressure values. Legend: amplituda zrýchlenia = amplitude of acceleration, frekvencia = frequency, rýchlosť = velocity, tlak = pressure.

❖ CONCLUSIONS

To summarize, presented experimental monitoring revealed that the pump pressure significantly affects generation of water jet technological head vibrations. Moreover, it was proved that these technological head vibrations can be reduced by simple adjusting of pump pressure which as a result can improve cutting edge quality of AWJ cutting.

❖ ACKNOLWLEDGEMENT

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